Chemistry syllabus

B.Sc. I Year

Semester –I

Paper-I

Physical Chemistry

Max Marks: 34

30Hrs. (2 Hrs /week)

UNIT-I :Mathematical Concepts

Logarithmic relations, curves stretching, linear graphs and calculation of slopes, Differentiation of functions like Kx, e^x, x^n, sinx, logx; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful / relevant functions; permutations and combinations. Factorials, Probability.

Unit II : Computers **6 Hrs.**

General introductions to computers, different components of a computers. Hardware and software, input-output devices, binary numbers and arithmetic; introduction to computer languages. Programming and operating systems.

Unit-3 Gaseous States **6 Hrs.**

Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of State.

Critical phenomenon: PV isotherms of ideal gases, continuity of states, the isotherms of van der Waals equations, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of states.

Unit IV: Velocities **6 Hrs.**

Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter. Liquification of gases(based on Joule Thompson effect).

Unit V: Liquid State **6 Hrs.**

Intermolecular forces, structure of liquids (a qualitative description)

Structural differences between solids, liquids and gases.

Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholestic phases. Thermography and seven segment cell.

B.Sc. I Year
Semester –I
Paper-II
Inorganic Chemistry

Max Marks: 33
30Hrs. (2 Hrs /week)

Unit I: Atomic Structure **6Hrs**

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of ψ and $\psi 2$, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rules. Electronic configurations of the elements, effective nuclear charge.

Unit II : Periodic Properties **6 hrs**

Atomic and ionic radii, ionization energy, electron Affinity and electronegativity: definition, method of determination, trends in periodic table and applications.

Unit III : Chemical Bonding -I **6 hrs**

Covalent bond- valence bond theory and its limitations, directional characteristic of covalent bond. Hybridization and shapes of simple molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to NH_3, SF_4, ClF_3, ICl_4^-.and H_2O

Unit IV: Chemical Bonding -II **6 hrs**

Molecular Orbital theory for homonuclear and heteronuclear (CO and NO) diatomic molecules, multi-center bonding in electron deficient molecules, bond strength and the bond energy, % ionic character from dipole moment and electronegativity difference. Weak interactions , hydrogen bonding, van der Waals forces.

Unit IV Ionic Solids **6 hrs**

Ionic structures , radius ratio effect and coordination number, limitation of radius ratio rule, Lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions. Fajan's rule, Metallic bond free electron, Valance bond and Band theories

B.Sc. I Year
Semester –I
Paper-III
Organic Chemistry

Max Marks: 33
30 Hrs. (2 Hrs /week)

Unit I Structure and Bonding **6Hrs**

Hybridizations, Bond lengths and bond angles, bond energy : Localized and delocalized chemical bond, van-der Waals interactions, inclusion compounds, clatherates, charge transfer complex, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic reactions : Curved arrow notations, drawing electron movement with arrows, half headed and double headed arrow, homolytic and heterolytic bond breaking

Unit I I Types of Reagents **6Hrs**

Electrophiles and nucleophiles. Types of organic reactions. Energy consideration. Reactive intermediates- carbocations, carbanions, free radicals and carbenes. Methods of determination of reaction mechanism.

Unit III Stereochemistry -I **6Hrs**

Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirallity, enantiomers, stereogenic centres, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, distereoisomers, mesocompounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configurations, sequence rules, D & L , R & S systems of nomenclature.

Unit IV Stereochemistry - 2 **6Hrs**

Nomenclature E and Z system, geometrical isomerism in alicyclic compounds. Conformation, conformational analysis of ethane and n-butane. Conformations of cyclohexanes, axial and equatorial bonds, Newman projection and Saw horse formulae, Fischer and Flying wedge formulae.

Unit V Alkanes and Cycloalkanes **6Hrs**

IUPAC nomenclature, classification, isomerism in alkanes, sources, and methods of preparation (with special reference to Wurtz, Kolbe', Corey'House, reactions and decaroxylation of carboxylic acids). Physical properties and chemical reactions of alkanes. Mechanism of free radical halogination of alkanes.

Cycloalkanes : nomenclature, methods of preparations, chemical reactions. Bayer's strain theory and its limitations. ring strain in cyclopropane and cyclobutanes. Theory of stainless rings.

B.Sc. I
Semester I
Practical

Max Marks: 50

Duration of practical during the semester: 90 hrs
Examination: 4 hours

Inorganic 12 Marks

Macro/semi-micro analysis- Cation analysis, separation of ions from group I-VI, anion analysis

Physical 12 Marks1.

1. Calibration of thermometer
2. Determination of melting point
3. Determination of boiling point
4. Determination of mixed melting point
5. Preparation of solutions of various concentrations, NaOH, HCl, H_2SO_4.

Organic 12 Marks

1. Distillation
2. Crystallization
3. Decolourasation and crystallization using charcoal
4. Sublimation

Viva-voce 6Marks

Record 8 Marks

B.Sc. I year
Semester II
Paper-I
Physical Chemistry

Max Mark : 34
30 Hrs (2 Hrs/week)

Unit-I Colloidal State **6Hrs**

Definition of colloids, classification of colloids. Solids in liquids (sols): properties- Kinetic, optical and electrical ; stability of colloids, protective action, Hardy-Schulz law, gold number. Liquids in liquids (emulsions) types of emulsions, preparation. Emulsifier. Liquids in solids (gels): classification, preparation and properties, inhibition, genera applications of colloids.

Unit-II Solid State **6Hrs**

Definition of space lattice, Unit cell Laws of crystallography - (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Laws of symmetry. Symmetry elements in crystals.

Unit-Ill: Diffraction **6Hrs**

X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure *of* NaCI, KC1 and CsCI (Laue'c method and powder method.) Catalysis. characteristics of catalysed reactions, classification of catalysis miscellaneous. Examples.

Unit-IV Chemical Kinetics-I **6Hrs**

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero. order, pseudo order, half life and mean life Determination of the order of reaction differential method, method of integration, method of half life period and isolation method.

Unit-V : Chemical Kinetics-II **6Hrs**

Experimental methods of chemical kinetics-conductometric, potentiometic, optical methods, polarimetry and spectrophotometer. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis.) Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

B.Sc. I year
Semester II
Paper-II
Inorganic Chemistry

Max Mark : 33
30 Hrs (2 Hrs/week)

Unit I: s-Block Elements **6 Hrs**

Comparative study, diagonal relationships, salient features of hydrides, salvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

Unit II p-Block Elements Part-I **6 Hrs**

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16

Unit III p-Block Elements Part-II **6 Hrs**

Hydrides of boron-diborane and higher boranes. Borazine, borohydrides

Unit IV p-Block elements Part-III **6 Hrs**

Fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens.

UnitV Noble Gases **6 Hrs**

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

B.Sc. I year
Semester II
Paper-III
Organic Chemistry

Max Mark : 33
30 Hrs (2 Hrs/week)

Unit-I Arenes and Aromaticity **6 Hrs**

Nomenclature of benzene derivatives. The aryl group Aromatic nucleus and side chain Structure of benzene molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure. MO picture. Aromaticity the Huckel rule, aromatic ions. Aromatic electrophilic substitution general pattern of the mechanism, role of (a and n complexes) Mechanism of nitration, halogenation. sulphonation. mercuration and Friedel-Crafts reaction Energy profile diagrams. Activating and deactivating substituents. orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl

Unit-II Alkenes **6 Hrs**

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regio-selectivity in alcohol dehydration the Saytzeff rule, Hoffmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation oxymercuration-reduction, Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, industrial applications of ethylene and propene.

Unit-Ill : Cycloalkanes, Dienes and alkynes **6 Hrs**

Methods of formation, conformation and chemical reactions of cycloalkenes nomemclature and classification of dienes: isolated conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions-1,2 and 1,4 additions, Diels Alder reaction. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidatiion and polymerization

Unit-IV Alkyl and Aryl Halides-I **6 Hrs**

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions echanims of nucleophilic substitution reaction of alkyl halides, S_N2 and S_N1 reactions, with energy profile diagrams. Polyhalogen compounds: chloroform, carbon tetrachloride.

Unit-V Alkyl and Aryl Halides-II

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides versus allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC, Freon.

Practical
Chemistry syllabus
B.Sc. I Year
Practical
Semester II

Max. Marks 50

Duration of practical during the semester: 90 hrs
Examination: 4 hours

Analysis:
(Organic Chemistry: 12 marks)

1. Detection of elements (N, S and halogens) ***2 elements, 4 marks***
2. Functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and aniline) in simple organic compounds.

2 functional groups: 8 marks

Physical Chemistry(one experiment only-12 marks)

1. To determine the velocity constant (specific reaction rate) of hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strength of HCl and H_2 SO_4 by studying the kinetics of hydrolysis of ester.
4. To study kinetically the reaction rate of decomposition of iodide by H_2O_2.
5. Determination of surface tension / percentage composition of given organic mixture using surface tension method.
6. Determination of viscosity / percentage composition of given organic mixture using viscosity method.

Inorganic: (4+8 marks)

1. Separation of cations by paper chromatography.
2. Preparation of ferrous alum.

Viva: 6 marks
Records: 8 marks

PROJECT (50 +50=100 marks)

The student has to perform a project work related to industrial/ regional needs.
(Out of two projects the first semester project will be evaluated by the internal examiner and the other will be evaluated by external examiner)

Chemistry syllabus

B.Sc. II Year

Semester –III

Paper-I

Physical Chemistry

Max Marks: 33
30Hrs. (2 Hrs /week)

Unit-I Thermodynamics – I **6Hrs**

Definition of thermodynamic terms : system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics : Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law -Joule-Thomson coefficient and inversion temperature. Calculation of W, q, dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Unit -II **6Hrs**

Thermochemistry : Standard state, standard enthalpy of formation - Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchoffs equation.

Second Law of Thermodynamics : need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Unit - III *Thermo dynamics-II* **6 Hrs**

Concept of entropy : Entropy as a state function, entropy as a function of V&T, entropy as a function of P&T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third Law of thermodynamics : Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data,

Unit-IV -*Thermodynamics-Ill* **6 Hrs.**

Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chateliers principle.

Reaction isotherm and reaction isochor - Clapeyron equation and Clausius - Clapeyron equation, applications.

Unit V : Phase Equilibrium **6 Hrs.**

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, ***phase equilibria of one component system*** - water, CO_2 and sulphur system.

Phase equilibria of two component system : solid -liquid equilibria, simple eutectic - Bi, Cd, Pb-Ag systems, desilverisation of lead.,

Solid solutions : compound formation with congruent melting point (Mg-Zn) and incongruent melting point, ($NaCl – H_20$), ($FeCl_3$-H_2O) and $CuSO_4$-H_2O system. Freezing mixtures, acetone dry ice.

B.Sc. II Year

Semester –III

Paper-II

Inorganic Chemistry

Max Marks: 34

30Hrs.

(2 Hrs /week)

Unit-I Chemistry of Elements of First Transition Series :- **6 Hrs.**

Characteristic properties of d-block elements. Properties of the elements of the first transition series their Binary compounds such as Carbides, Oxides and Sulphides.

Unit-II: Complexes **6 Hrs.**

Complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Unit-III: Transition elements-I **6 Hrs.**

Chemistry of Elements of Second and Third Transition Series:- General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states.

Unit-IV: Transition elements-II **6 Hrs.**

Comparative treatment of elements of second and third transition series

magnetic behaviour, spectral properties and stereochemistry.

Unit-V Coordination Compounds **6 Hrs.**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition

B.Sc. II Year

Semester –III

Paper-III

Organic Chemistry

Max Marks: 33

30Hrs. (2 Hrs /week)

Unit I Electromagnetic Spectrum: Absorption Spectra 6Hrs.

Ultraviolet (UV) absorption spectroscopy - absorption laws (Beer-Lambert's law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic. hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones

Unit-II : Infrared (IR) absorption spectroscopy 6 Hrs.

Molecular vibrations. Hooke's law, selection rules, intensity an deposition of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

Unit III: Alcohols 6 Hrs

Classification and nomenclature. ***Monohydric alcohols*** - nomenclature, methods of formation of reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature, Reactions of alcohols.
Dihydric alcohols - nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement. ***Trihydric alcohols*** - nomenclature and methods of formation, chemical reactions of glycerol.

Unit-IV : Aldehydes and Ketones-I 6 Hrs.
Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketone using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevengel condensations.

Unit-V: Aldehydes and Ketones-II 6 Hrs.
Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction.
Use of acetais as protecting group. Oxidation cf aldehydes, Baeyer-Villiger oxidation ol ketones. Cannizzaro's reaction. Meerwine Pondorof Verlay, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones. An introduction to α, β unsaturated aldehydes and ketones.

B.Sc. II
Semester III
Practical

Max Marks: 50

Duration of practical during the semester: 90 hrs
Examination: 4 hours

Inorganic: (4 marks)

1. Calibration of fractional weights, pipettes and burettes. Preparation of standard solutions. Dilution 0.1 M to 0.001 M solutions.

2. **Quantitative Analysis** (Either Volumetric or Gravimetric)

Volumetric Analysis (**14 marks**)

(a) Determination of acetic acid in commercial vinegar using NaOH
(b) Determination of alkali content- antacid tablet using HC1
(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.
(d) Estimation of hardness of water by EDTA

3. **Gravimetric Analysis**

Analysis of Cu as CuSCN and Ni as Ni(dimethylglyoxime)

Organic Chemistry (18 marks)

Laboratory Techniques

Thin Layer Chromatography:

Determination of Rf values and identification of organic compounds.

1. Separation of green leaf pigments (spinach leaves may be used)
2. Preparation and separation of 2,4 - dinitrophenylhydrazones of acetone, 2-butanone, hexane-2 and 3-one using toluene and light petroleum (40:60) as solvent system.
3. Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5) as solvent system.

Paper Chromatography: Ascending and Circular

Determination of Rf values and identification of organic compounds.

(a) Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent-ninhydrin.
(b) Separation of a mixture of D, L-alanine, glycine and L-Leucine using n-butanol: acetic acid : water (4:1:5) Spray reagent-ninhydrin.
(c) Separation of monosaccharides- A mixture of D-galactose and D-fructose using n-butanol:acetone:water (4.1:5) Spray reagent aniline hydrogen phthalate.

Viva voce: 6 marks

Records: 8 marks

Chemistry syllabus

B.Sc. II Year

Semester –IV

Paper-I

Physical Chemistry

Max Marks: 33
30Hrs. (2 Hrs /week)

Unit-I : liquid-liquid mixtures **6 Hrs.**

Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system azeotropes : HCl-H_20 and ethanol - water systems.

Partially miscible liquids - Phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature. Immiscible liquids, steam distillation.

Nernst distribution law - thermodynamic derivation, applications.

Unit II: Electrochemistry -1 **6 Hrs.**

Electrical transport - Conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrauscb law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations.

Unit -III Electrochemistry – II **6 Hrs.**

Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements : determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Unit - IV Electrochemistry – III **6 Hrs**.

Types of reversible electrodes : gas metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions. Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells, reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (AG_5 AH and K), polarization, over potential and hydrogen overvoltage.

Unit - V Electrochemistry and Corrosion **6 Hrs**.

Concentration cells with and without transport, liquid junction potential, application of conc cells, valency of ions, solubility product and activity coefficient, potentiometric titaration

Definition of pH and pK, determination of $_PH$ using hydrogen, quinhydrone and glass electrodes by potentiometric method,

Buffers- Mechanism of buffer action, Handerson Hazel equation, hydrolysis of salts. **Corrosion** : types, theories and methods of comobating it.

B.Sc. II Year

Semester –IV

Paper-II

Inorganic Chemistry

Max Marks: 34

30Hrs. (2 Hrs /week)

Unit-I Oxidation and Reduction **6 Hrs**

Use of redox potential data - analysis of redox cycle, redox stability in water - Frost,

Latimer and Poubaix diagrams principles involved in the extraction of the elements.

Unit-II Chemistry of Lanthanide Elements **6 Hrs,**

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex

formation, occurrence and isolation of lanthanide compounds

Unit-Ill Chemistry of Actinides **6 Hrs.**

General features and chemistry of actinides, chemistry of separation of Np, Pu, and Am from U, similarities between the later actinides and the later lanthanides.

Unit-IV Acids and Bascs **6 Hrs**

Arrhenius, Bronsted - Lowry, the Lux-Flood solvent system and Lewis concepts of acids and bases.

Unit - V Non-aqueous Solvents **6 Hrs**

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Physical properties of solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO2.

B.Sc. II Year

Semester –IV

Paper-III

Organic Chemistry

Max Marks: 33

30Hrs. (2 Hrs /week)

Unit – I Phenols **6 Hrs**

Nomenclature, structure and bonding, Preparation *of* phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols - electrophillic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gaiterman synthesis, Hauoen-Hoesch reaction. Lederer-Manasse reaction and Reimer-Tiemann reaction.

Unit II- Carboxylic Acids **6 Hrs.**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation, methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids; methods of formation and effect of heat and dehydrating agents, haloacids, hydroxy acids- Malic, tartaric & citric acid.

Unit III Carboxylic Acid Derivatives **6 Hrs**.

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions, Mechanisms of esterification and hydrolysis (acidic and basic).

Ethers and Epoxides : Nomenclature of ethers and methods of their formation, physical properties. Chemical reactions - cleavage and autoxidation, Ziesel's method. Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Unit IV Organic Compounds of Nitrogen-I **6 Hrs.**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic Substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid. Halonitroarenes: reactivity, structure and nomenclature of amines, physical properties.

Unit-V Organic Compounds of Nitrogcn-II **6 Hrs**.

Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive animation of aldehydic and ketonic compounds. Gabriel-Phthalamide reaction, Hoffmann bromamide reaction. Reactions of amines, electrophilic aromatic Substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

B.Sc. II
Semester IV
Practical

Max Marks: 50

Duration of practical during the semester: 90 hrs
Examination: 4 hours

Organic Chemistry
Qualitative Analysis (12 marks)
Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Physical Chemistry (12+12 marks) Two experiments

Transition Temperature

1. Determination of the transition temperature of the given substance by thermometric method(e.g. $MnCl_2.4H_2O/SrBr_22H_2O$).

Phase Equilibrium

1. To study the effect of a solute (e.g. NaCI succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system and to determine the concentration of that solute in the given phenol-water system.
2. To construct the phase diagram of two component (e.g. diphenylamine-benzophenone system by cooling curve method.)

Thermochemistry

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1. To determine the enthalpy of neutralization of a weak acid/ week base versus base/ strong acid and determine the enthalpy of ionization of the weak acid base.

Viva: 6 marks
Records: 8 marks

PROJECT (50 +50=100 marks)

The student has to perform a project work related to industrial/ regional needs.
(Out of two projects the first semester project will be evaluated by the internal examiner and the other will be evaluated by external examiner)

Chemistry syllabus

B.Sc. III Year

Semester – V

Paper-I

Physical Chemistry

Max Marks: 33
30Hrs. (2 Hrs /week)

Unit I Elementary Quantum Mechanics 6 Hrs

Black-body radiation, Planck's radiation law, photoelectric effect:. heat capacity of solids, Bohr's model of hydrogen atom (no derivation and its defects. Compton effect. De Brogile hypothesis, Heisenberg's uncertainty principle. Sinusoidal wave equation. Hamiltonian operator. Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics. particle in a one dimensional box.

Unit II Molecular orbital theory-I 6 Hrs

Molecular orbital theory., basic ideas - criteria for forming M.O. from A.O.. construction of M.O.'s by LCAO- hydrogenion. calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions.

Unit III Molecular orbital theory-II 6 Hrs

Concept of sigma sigma star, Pi-Pi star orbitals and their characteristics. Hybrid orbitals - sp, sp^2 , sp^3; calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H_2 comparison cf M.O. and VB. models.

Unit IV Electronic Spectrum 6 Hrs

Concept of potential energy curves for bonding and antibonding molecular orbitals. qualitative description of selection rules and Frank-Condon principle. Qualitative description of a, SIGMA, PI and n M O., their energy levels and the respective transitions.

Unit V Photochemistry 6 Hrs

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry : Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield photosensitized reactions-energy transfer processes (simple examples).

B.Sc. III Year

Semester – V

Paper-II

Inorganic Chemistry

Max Marks: 33

30Hrs. (2 Hrs /week)

Unit I : Metal ligand bonding in transition metal complexes 6 Hrs

Limitations of valence bond theory, an elementary idea of crystal field thery, Crystal field splitting in octahedral, tetrahedral and squareplanner complexes, factors affecting the Crystal field parameters.

Unit II : Thermodynamics and kineticaspects of metal complexes 6 Hrs

A brief out line of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planner complexes,

Unit III : Magnetic properties of transition metal complexes 6 Hrs

Types of magnetic behaviour, Methods of determining magnetic susceptibility, spin (only formula) LS coupling, correlation of μs (spin only) and μeffective values. Orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

Unit IV : Electron spectra of transition metal complexes-I 6 Hrs

Types of electronic transitions, selection rules for d-d transition, spectroscopic ground states, spectrochemical series,

Unit V : Electron spectra of transition metal complexes-II 6 Hrs

Orgel energy level diagram for d^1 –d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$.

B.Sc. III Year

Semester – V

Paper-III

Organic Chemistry

Max Marks: 34

30Hrs. (2 Hrs /week)

Unit I Spectroscopy -I 6 Hrs

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance(^{1}H NMR) spectrescopy. nuclear shieding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals. Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol , acetaldehyde, 1,1.2-tribromoethane, ethyl acetate, toluene and acetophenone.

Un it II Structure elucidation 6 Hrs

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

Unit III Organometallic Compounds 6 Hrs

Organomagnesium compounds : the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds : formation and chemical reactions. Organolithlum compounds : formation and chemical reactions. Organosulphur Compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and suiphaguanidine.

Unit IV Synthetic Polymers 6 Hrs

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

Unit – V Heterocyclic Compounds 6Hrs

Introduction : Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six-membered heteroeycies. Preparation and reactions of Indole, quinoline and isoquinolme with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

B.Sc. III
Semester V
Practical

Max Marks: 50

Duration of practical during the semester: 90 hrs
Examination: 5 hours

Organic chemistry: 12 marks

Qualitative analysis of organic mixture containing two solid component using water, NaOH, $NaHCO_3$ for separation, prepare suitable derivative.

Physical Chemistry: 12 Marks

Electrochemistry

a) To determine the strength of the given acid conductometrically using standard alkali solution. b) To determine the solubility and solubility product of a sparingly soluble electrolyte

conductometrically

c) To study the saponification of ethyl acetate conductometrically.

d) To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMn0_4/K_2Cr_2O_7$ as

titrant and calculate the redox potential of Fe^{++}/Fe^{+++} system on the hydrogen scale.

Refractometry, Polarimetry.

(a) To verify law of refraction of mixture (e.g. of glycerol and water) using Abb's refractometer.

(b) To determine the specific rotation of a given optically active compound.

.**Colorimetry**

To very Beer-Lambert law for $KMnO_4$ / $K_2Cr_2O_7$ and determine the concentration of the - given solution of the substance.

Inorganic Chemistry: 12 Marks

Solvent Extraction:

Separation and estimation of Mg(II) and Fe(II).

Ion exchange method

Separation and estimation of Mg(II) and Zn (II).

Viva: 6 marks

Records: 8 marks

Chemistry syllabus

B.Sc. III Year

Semester –VI

Paper-I

Physical Chemistry

Max Marks: 33
30Hrs. (2 Hrs /week)

Unit 1 **Spectroscopy-I** **6Hrs**

Introduction : electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Bo!tzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect

Unit 11 **Specroscopy-II: Vibrational Spectrum** **6Hrs**

Infrared spectrum : Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups

Unit III **Spectroseopy-III: Raman spectrum** **6Hrs**

Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Unit IV **Physical Properties and Molecular Structure** **6Hrs**

Optical activity, polarization - (Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment.

Measurement of dipole moment- temperature and refractivity method, dipole moment and structure of molecules, magnetic properties- paramagnetism, diamagnetism and ferromagnetics.

Unit V **Solutions, Dilute Solutions and Colligative Properties** **6Hrs**

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation uf boiling point and depression of freezing point. Thermodynamic derivation of relation between molecular weight and elevation m boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

B.Sc. III Year

Semester –VI

Paper-II

Inorganic Chemistry

Max Marks: 33
30Hrs. (2 Hrs /week)

Unit I **Hard and Soft Acids and Bases (HSAB)** **6Hrs**

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acic-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

Unit II **Silicones and Phosphazenes** **6Hrs**

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes

Unit III **Organometallic Chemistry I** **6Hrs**

Definition, nomenclature and classification of organometallic compounds Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, *Hz.* Sn and Ti.

Unit IV **Organometallic Chemistry II** **6Hrs**

A brief account c: metal-ethylenic complexes and homogeneous hydrcgenatier, mononuclear carbonyls and the nature of bonding in metal carbcnyls.

Unit V **Bio-inorganic Chemistry** **6Hrs**

Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin

Biological role of alkali and alkaline earth metal ions with special reference to Ca^{++}. Nitrogen fixation.

B.Sc. III Year

Semester –VI

Paper-III

Organic Chemistry

Max Marks: 34

30Hrs. (2 Hrs /week)

Unit I **Carbohydrates** **6Hrs**

Classification and nomenclature. Monosaccharides, mechanism *of osazone* formation. interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diaestereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esteres. Determination of ring size *of* monosaccharides. Cyclic structure of D(+) glucose. Mechanism of mutarotatiom Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

Unit – II **Fats Oils and Detergents** **6Hrs**

Natural fats, edible and industrial oils of vegetable origin, common fatty acids. glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates

Unit – III **Amino acids, peptides and proteins** **6Hrs**

Classification, structure and stereochemistry of amino acids, Acid base behaviour,

Unit IV **Nucleic acids** **6Hrs**

Nucleic acid, Introduction, Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Synthetic Dyes: Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Unit – V **Organic Synthesis via Enolates** **6Hrs**

Organic Synthesis via Enolates Acidity of of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Syntbesis of ethyl acetoacetate, the Claisen condensation. Keto-enol tautcmerism of ethyl acetoacetate. , Alkylaticn of 1.3-dithianes. Alkylation and acylation of enamines

B.Sc. III
Semester VI
Practical

Max Marks: 50

Duration of practical during the semester: 90 hrs
Examination: 5 hours

Inorganic chemistry: 12 marks
Preparations:

a. **sodiumtrioxalatoferrate(III)**
b. **Ni-DMG complex**
c. **Coppertetraamine complex**
d. **Cis and trans bisoxalatodiaquachromate(III) ions.**

Organic: 12 marks
Preparations:

(a) Acetylation
(b) Benzoylation
(c) aliphatic electrophilic substitution
(d) aromatic electrophilic substitution
(e) meta di-nitrobenzene
(f) picric acid
(g) benzoic acid

Physical Instrumentation: 12 marks
Job's method
Mole ratio method
effluent analysis
water analysis

Viva: 6 marks
Records; 8 marks

PROJECT (50 +50=100 marks)

The student has to perform a project work related to industrial/ regional needs.
(Out of two projects the first semester project will be evaluated by the internal examiner and the other will be evaluated by external examiner)

Books Suggested (Theory Courses)

1 - Basic Inorganic Chemistry, F.A. Cotton$_9$ G. Wilkinson and P.L. Gaus, Wiley. |

2. Concise Inorganic Chemistry, J.D. Lee, ELBS*
3.. Concepts of Models of Inorganic Chemistry, B.Douglas, D.McDaniel and J Alexander, John Wiley.
4. Inorganic Chemistry, D.E.Shriver, P*W. Atkins and C.HL Langford, Oxford.
5. Inorganic Chemistry, WW. Porterfield, Addison - Wesley.
6. Inorganic Chemistry, A.G. Sharpe, ELBS
7. Inorganic Chemistry, G.L. Meissler and *D.A.* Tarr, Prentic-Hall
8. Organic Chemistry, Morrison and Boyd, Prentice Hall.
|9. Organic Chemistry, L.G. Wade Jr. Prentice Hall
10. Fundamentals of Organic Chemistry Solomons, John Wilev.
11. Organic Chemistry, Vol. I, IL IIL S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
12. Organic Chemistry, F.A. Carey, McGraw-Hill Inc.
13. Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan.
14. Physical Chemistry. G.M. Barrow. International Student Edition, McGraw Hill.
15. Basic Programming with Application, V.K. Jain, Tata McGraw Hill.
16. Computers and Common Sense, R. Hunt and Shelly, Prentice Hall.
17. University General Chemistry, C.N.R. Rao, MacmilLn.
18. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
20. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.